

CLAIMS

1. A fluorometer comprising an excitation system including an excitation source for producing excitation light capable of causing fluorescence in fluorescent material; and a detection system for detecting said fluorescence, wherein said excitation source comprises one or more light emitting diodes (LEDs) associated with means for causing said excitation light to form a beam that projects, during use, from the fluorometer to enable the detection of fluorescent material located remotely from the fluorometer.
2. A fluorometer as claimed in Claim 1, wherein said beam causing means comprises a system of at least one lens.
3. A fluorometer as claimed in Claim 2, wherein the lens system comprises at least one collimating lens.
4. A fluorometer as claimed in Claim 2 or 3, wherein said excitation source is located substantially at the focal point of the nearest to the excitation source of said at least one lens.
5. A fluorometer as claimed in any preceding claim, wherein said beam causing means includes a collimator.
6. A fluorometer as claimed in any preceding claim, wherein said excitation source comprises a plurality of LEDs arranged in a generally rectangular and at least one dimensional array.
7. A fluorometer as claimed in any preceding claim, comprising means for modulating said beam of excitation light with a modulating signal having a modulation frequency.

8. A fluorometer as claimed in Claim 7, wherein said modulating means is arranged to amplitude modulate said beam.
- 5 9. A fluorometer as claimed in Claim 7 or 8, wherein said modulating means modulates said beam by adjusting the power supply of the excitation source in accordance with said modulating signal.
- 10 10. A fluorometer as claimed in any preceding claim, wherein said beam is generally conical in shape.
11. A fluorometer as claimed in any preceding claim, wherein the detection system comprises means for receiving light and for converting said received light into a corresponding electrical signal.
- 15 12. A fluorometer as claimed in Claim 11, wherein said light receiving and converting means comprises a photodetector.
- 20 13. A fluorometer as claimed in Claim 11 or 12, wherein the detection system comprises a system of at least one lens, the arrangement being such that the lens system directs said received light onto said light receiving and converting means.
- 25 14. A fluorometer as claimed in Claim 13, wherein said lens system includes at least one collimating lens.
- 30 15. A fluorometer as claimed in Claim 13 or 14, wherein said lens system is arranged to provide a generally conical detection volume for the detection system.
16. A fluorometer as claimed in any one of Claims 13 to 15, wherein said light receiving and converting means is located substantially at the focal point of the nearest to said light receiving and converting means of said at least one lens.

17. A fluorometer as claimed in any one of Claims 13 to 17, wherein said detection system further includes, or is associated with, means for detecting, in the electrical signal produced by said light receiving and converting means, a signal component of substantially the same frequency as said modulation frequency.
18. A fluorometer as claimed in Claim 17, wherein said detecting means is arranged to detect, in the electrical signal produced by said light receiving and converting means, a signal component of substantially the same frequency as said modulation frequency and substantially in phase with the modulation of said beam.
19. A fluorometer as claimed in Claim 17 or 18, wherein said detecting means includes means for performing spectral analysis of the electrical signal produced by the light receiving and converting means and means for determining the value of the spectral component of said electrical signal corresponding to said modulation frequency.
20. A fluorometer as claimed in any preceding claim, wherein the excitation system and the detection system are each provided in a respective housing, the respective housings being located adjacent one another and arranged such that there is an overlap, during use, between the excitation beam emanating from the excitation system housing and the detection volume of the detection system housing.
21. A fluorometer as claimed in Claim 20, wherein the respective housings are adjustably interconnected so that the relative angular disposition between the respective housings may be altered.

22. A fluorometer as claimed in Claim 21, wherein the respective housings lie generally in a common plane, the relative angular disposition of the housings being alterable about an axis that is substantially perpendicular to said plane.

23. A fluorometer as claimed in any one of Claims 1 to 19, wherein the
5 excitation system and the detection system are located in a common housing.

24. A fluorometer as claimed in Claim 23, wherein said common housing comprises a window and at least one inner chamber, at least part of the excitation system and at least part of the detection system being located in said at least one
10 inner chamber, said at least part of the excitation system being arranged so that said beam is projected, during use, out of the housing through said window, said at least part of the detection system facing away from said window, and wherein a reflecting surface is located inside the housing facing said window and beyond the detection system with respect to said window, said reflecting surface being
15 arranged to direct light entering, during use, said housing through said window onto said detection system.

25. A fluorometer as claimed in Claim 25, wherein said at least part of the excitation system and said at least part of the detection system are located
20 substantially co-axially with one another within said housing.

26. A fluorometer as claimed in Claim 24 or 25, in which said at least one inner chamber is located substantially on the longitudinal axis of said housing.

27. A fluorometer as claimed in Claim 23, wherein said common housing comprises a window and at least two inner chambers, at least part of the excitation system being located in a first inner chamber and at least part of the detection system being located in a second inner chamber, said at least part of the excitation system being arranged so that said beam is projected, during use, out of the
30 housing through said window, said second inner chamber being located beyond said first inner chamber with respect to said window, said at least part of the

detection system facing towards said window, and wherein a reflecting system is located between the first and second inner chambers and is arranged to direct light entering, during use, said housing through said window onto said detection system.

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28. A fluorometer as claimed in Claim 27, wherein said reflecting system comprises a first reflecting surface facing towards said window and a second reflecting surface facing away from said window, the first reflecting surface being arranged to direct light entering, during use, said housing through said window
10 onto said second reflecting surface, said second reflecting surface being arranged to direct said light onto said detection system.

29. A fluorometer as claimed in Claim 28, wherein said first reflecting surface is shaped to define an aperture, said detection system being positioned to receive
15 light from said second reflecting surface through said aperture.

30. A fluorometer as claimed in any one of Claims 27 to 29, wherein said reflecting system comprises a Cassegrainian mirror system.

20 31. A fluorometer as claimed in any preceding claim, further including a laser device carried by the fluorometer and positioned to project, during use, a laser beam in a direction generally parallel, or aligned, with the excitation beam.

32. A fluorometer as claimed in any preceding claim, wherein fluorometer
25 comprises at least one housing, the or each housing comprising a window through which said excitation beam is projected during use and/or through which light is received during use, wherein said excitation source is slidably moveable towards and away from the window of the housing in which it is located.

30 33. A fluorometer as claimed in any preceding claim, wherein fluorometer comprises at least one housing, the or each housing comprising a window through

which said excitation beam is projected during use and/or through which light is received during use, wherein at least one lens of said lens system is slidably moveable towards and away from the window of the housing in which it is located.

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34. A fluorometer as claimed in any one of Claims 24 to 30, wherein fluorometer comprises at least one housing, the or each housing comprising a window through which said excitation beam is projected during use and/or through which light is received during use, wherein at least one reflecting surface is slidably moveable
10 towards and away from the window of the housing in which it is located.

35. A fluorometer as claimed in any one of Claims 17 to 19, further including means for determining the amplitude of said signal component, and means for generating an alarm when said amplitude exceeds a threshold.

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36. A vehicle for use underwater, the vehicle carrying a fluorometer as claimed in any preceding claim.

37. A vehicle as claimed in Claim 36, wherein the vehicle includes at least one
20 first moveable structure for carrying, during use, a camera or lamp, the fluorometer being carried by a second moveable structure, wherein said at least one first moveable structure and said second moveable structure are coupled electrically and/or mechanically so that the movement of the second structure is synchronised with the movement of said at least one first structure.

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38. In a fluorometer comprising an excitation system including an excitation source for producing excitation light capable of causing fluorescence in fluorescent material; and a detection system for detecting said fluorescence, wherein said excitation source comprises one or more light emitting diodes
30 (LEDs) associated with means for causing said excitation light to form a beam that projects, during use, from the fluorometer, a method of detecting fluorescent

material, the method comprising, generating an excitation beam; and detecting fluorescence caused by the incidence of said excitation beam on fluorescent material.